NavMed 369

UNITED STATES NAVY

MEDICAL NEWS LETTER

Rear Admiral Bartholomew W. Hogan MC USN - Surgeon General
Captain Donald R. Childs MC USN - Editor

Vol. 34 Friday, 2 October 1959 No. 7

TABLE OF CONTENTS

HISTORICAL FUND
of the
NAVY MEDICAL DEPARTMENT

A committee has been formed with representation from the Medical Corps, Dental Corps, Medical Service Corps, Nurse Corps, and Hospital Corps for the purpose of creating a fund to be used for the collection and maintenance of items of historical interest to the Medical Department. Such items will include, but will not be limited to, portraits, memorials, etc., designed to perpetuate the memory of distinguished members of the Navy Medical Department. These memorials will be displayed in the Bureau of Medicine and Surgery and at the National Naval Medical Center. Medical Department officers, active and inactive, are invited to make small contributions to the fund. It is emphasized that all donations must be on a strictly voluntary basis. Funds received will be deposited in a Washington, D. C. bank to the credit of the Navy Medical Department Historical Fund, and will be expended only as approved by the Committee or its successor and for the objectives stated.

It is anticipated that an historical committee will be organized at each of our medical activities. If you desire to contribute, please do so through your local historical committee or send your check direct, payable to Navy Medical Department Historical Fund, and mail to:

Treasurer, N.M.D. Historical Fund
Bureau of Medicine and Surgery (Code 14)
Department of the Navy
Washington 25, D. C.

Committee

F. P. GILMORE, Rear Admiral (MC) USN, Chairman
C. W. SCHANTZ, Rear Admiral (DC) USN
L. J. ELSASSER, Captain (MSC) USN
R. A. HOUGHTON, Captain (NC) USN
T. J. HICKEY, Secretary-Treasurer

Acute Tubular Necrosis

The mortality rate from acute tubular necrosis should be low because: (1) the damaged renal tubule is able to undergo relatively complete regeneration; (2) physiologic principles have been applied to minimize fluid and electrolyte alterations which accompany acute renal failure; and (3) there has been almost universal acceptance of hemodialysis as a procedure capable of improving many of the biochemical abnormalities and symptoms attributable to them. However, despite reports that would indicate achievement of the objective, discouraging results are being obtained at renal centers with the most experience and equipment. The mortality rate of the authors' series of 100 cases of acute tubular necrosis was 50%.

Results of the present study indicate that prognosis is related both to the nature of the injury leading to renal damage and to ensuing complications. Improved survival rate requires further efforts directed toward the understanding and prevention of complications.

Analysis of the cases according to etiologic background reveals significant differences in mortality rates. The cases were divided according to common factors in development of tubular necrosis: (1) surgery, (2) trauma, (3) transufsion hemolysis, (4) obstetrical complications, (5) exposure to nephrotoxic agents, and (6) unknown or miscellaneous factors.

In the majority of patients who developed oliguria after a surgical procedure there was a significant fall in blood pressure of varying duration, but oliguria continued after restoration of blood pressure to normal. In 4 patients there was no fall in peripheral blood pressure; nevertheless, the pathogenesis of renal failure was probably the same—a marked reduction in renal blood flow without an accompanying peripheral vascular collapse.

Of 32 cases in this group, there were 23 fatalities (72%) with deaths due to complications arising after onset of renal failure.

The group receiving trauma and then developing tubular necrosis consisted of 6 patients, 5 of whom died of their disease combination. The renal lesion was thought to be directly responsible for death in 2 patients.

Twenty-four patients were included in the group suffering transfusion hemolysis. The mortality rate was 29% with 6 of the 7 fatalities resulting from transfusions that were not unequivocally indicated. There was no correlation between the amount of incompatible blood given and severity of renal damage.

Sixteen patients developed acute renal failure as a result of obstetrical complications, and death of 4 resulted.

Tubular necrosis developed in 9 patients who were exposed to nephrotoxic substances—carbon tetrachloride and bichloride of mercury. There were 5 deaths with 3 of them being attributable to the toxic agent.

Thirteen patients were included in the category of renal damage resulting from miscellaneous factors, such as the procedure involved in

performing an aortogram, nontraumatic rupture of the spleen, severe infections, and dehydrations. The mortality rate in this group was 46%.

Reasons for differences in mortality are not clear. While the extent and distribution of the tubular lesions are known to vary according to etiologic background, this is of doubtful clinical significance. Such factors as disease in other organs, presence of devitalized tissue, increased portals of entry for infection, and accelerated catabolic response are equally as important as the extent of renal damage in determining outcome of any case. These complicating factors and their effect upon the metabolism of urea, potassium, and phosphorus have been stressed by many writers.

Age and sex appear to have no relationship to survival, while duration of oliguria has an inverse relationship. Of all fatalities, 42% occurred during the diuretic period, even after the restoration of a normal BUN and achievement of peak urinary volume. As would be expected, pre-existing renal disease contributes to a prolonged and more complicated course.

All patients developed the symptom complex of "uremia" to a greater or lesser degree. Certain specific complications were considered to be of particular importance in management and prognosis of these patients.

Infection was the most frequent complication observed. Some evidence of infection was manifested by 80% during the course of disease. In 27 the infection was minor, such as cystitis or superficial wound abscess; in 53 it was of consequence, consisting of one or more of such entities as pneumonia, tracheobronchitis, septicemia, peritonitis, deciduitis, or parotitis. Infection played a major part in 72% of all deaths.

The highest incidence of major infection occurred in the surgical and miscellaneous groups; the lowest in the hemolytic transfusion and nephrotoxic groups, suggesting some correlation between incidence of infection and degree of initial tissue damage.

Unfortunately, not only does the acutely uremic patient appear more susceptible to bacterial invasion, but the infectious process is extremely difficult to control. Response to antibiotics is generally poorer than that of the nonuremic patient. The few studies which have been attempted to assess the influence of renal failure on natural defense mechanisms against bacteria have failed to show impairment of antibody response, complement production, or leukocyte phagocytosis.

Five patients died from potassium intoxication although the incidence of hyperkalemia (41%) was much higher. The rate of rise of the serum potassium bears important implications not only with regard to the potential danger of cardiac arrest, but also as a reflection of the catabolic response of the patient.

Cardiopulmonary complications other than those of infection developed in 49% of patients and were primarily responsible for death in 12. These included cardiac arrhythmias, congestive heart failure, and a peculiar syndrome resembling pulmonary embolism clinically but not pathologically.

Coma and convulsions are the two most important disturbances of the central nervous system that accompany acute tubular necrosis. Their importance as being a cause of death is difficult to assess. Incidental results of coma are more serious than the condition itself. Pneumonia, decubitus ulcers, aspiration of vomitus, tracheal obstruction, and urinary retention are all conditions which may develop and are of serious import in regard to prognosis.

Attempts to define the biochemical disturbances responsible for central nervous system depression have not been successful, although such compounds as phenols and guanidine have been implicated at one time or another.

Generalized convulsions occurred in 27 patients. The greatest danger from this complication is the associated anoxia with accentuation of an already threatening hyperkalemia. The etiologic factor of this phenomenon also is obscure.

Bleeding tencency is recognized as a common complication of both acute and chronic uremia. In this series, 49% of patients bled at some time during their illness exclusive of the period during or immediately following dialysis. From study of coagulation factors in instances of bleeding in these cases, it is suggested that other factors, such as capillary fragility, may play a major role, as coagulation defects in themselves do not appear to be statistically different in the bleeding and nonbleeding groups.

Tissue repair is defective in patients with uremia, resulting in delay in wound healing which contributes to the development of infection, depletion of labile protein stores, and possibly the biochemical abnormalities of uremia.

Although it is not the purpose of this report to detail the management of acute renal failure, several points with respect to prevention and treatment of complications need to be emphasized.

The greatest salvage of life in patients with acute tubular necrosis will stem from prophylaxis against infection. This requires constant surveillance and careful attention to details of good medical and nursing care. Attention to the respiratory tract is one of the most important facets of management, and maintenance of meticulous oral hygiene is mandatory. Physical activity—within the patient's tolerance—during the acute stage of the disease and as early in convalescence as is practicable, is desirable. Catheterization of the urinary bladder is to be avoided—the only absolute indication being lower urinary tract obstruction. Infection must be treated boldly with specific agents.

Temporary measures—intravenous hypertonic glucose with insulin, calcium gluconate, and sodium lactate—may be used when indicated for reduction of serum potassium level. Longer lasting effects may result from oral or rectal administration of cation exchange resins which remove potassium from the body, although dialysis remains the most efficient method for removal of potassium.

Recognition of the necessity for fluid restriction in these patients will lead to decreased incidence of congestive heart failure. Under average conditions normal hydration in the adult patient can be maintained by daily administration of approximately 600 ml. of fluid in addition to measured loss. When extrarenal losses are excessive, daily weights provide a more reliable index of fluid balance. Digitalis must be employed with caution and careful clinical observation.

Therapeutic attempts to improve blood coagulation and control bleeding tendencies are disappointing. Platelet transfusions, thromboplastic substances, and fresh-frozen plasma are theoretically indicated but notably ineffective. Judicious surgical intervention at times may pay dividends.

At present, the therapy of delayed wound healing consists mostly of local measures.

In the series reported, extracorporeal hemodialysis was performed 69 times on 52 patients. The fact that the mortality rate of dialyzed patients was identical with that of other patients (50% in each instance) has no real significance as the two groups were not comparable considering the severity of illness. Unequivocal evidence that dialysis will reduce the mortality rate in this disease must await analysis of larger, well-controlled series of patients with common etiologic background. It seems reasonable to believe that if dialysis is performed relatively early in the course of uremia, clinical deterioration may be prevented or delayed sufficiently to avoid some of the serious complications discussed in this paper. Consequently, the authors are inclined to agree with others that dialysis will be most effective when carried out earlier and more frequently than has been customary in the past. (Bluemle, L. W. Jr., Webster, G. D. Jr., Elkinton, J. R., Acute Tubular Necrosis - Analysis of One Hundred Cases with Respect to Mortality, Complications, and Treatment with and without Dialysis: A. M. A. Arch. Int. Med., 104: 180-195, August 1959)

* * * * * *

Policy

The U.S. Navy Medical News Letter, is basically an official Medical Department publication inviting the attention of officers of the Medical Department of the Regular Navy and Naval Reserve to timely up-to-date items of official and professional interest relative to medicine, dentistry, and allied sciences. The amount of information used is only that necessary to inform adequately officers of the Medical Department of the existence and source of such information. The items used are neither intended to be, nor are they, susceptible to use by any officer as a substitute for any item or article in its original form. All readers of the News Letter are urged to obtain the original of those items of particular interest to the individual.

Articular Manifestations of Chronic Ulcerative Colitis

The belief appears to be well established that arthritis is an occasional complication of chronic ulcerative colitis, that its presence is an additional indication for surgical management of colitis, and that removal of the diseased colon results in remission of arthritic symptoms. The literature is vague, however, regarding the type of arthritis involved and its rate of occurrence.

The author studied the records of 555 patients with chronic ulcerative colitis seen at the Lahey Clinic from 1926 through 1955 in an attempt to classify articular manifestations of chronic ulcerative colitis, to estimate their frequency in a large group of patients, and to correlate them to the activity of colitis.

Of the patients with chronic ulcerative colitis in this study, 290 (52.3%) were women; no sex differential was found regarding age at onset; in 80% the disease began in the second, third, or fourth decades; articular manifestations occurred in 95 patients (17%) of whom 54 were women; of the entire group, 335 (60.3%) underwent colectomy and ileostomy.

Rheumatoid arthritis occurred in 18 patients (3.2%) of whom 11 were women. The joint disease developed a year or more after onset of colitis in 14, and activity of the arthritis closely paralleled the ebb and flow of colitis in 8 patients. In the remaining 10 patients the two diseases apparently followed independent courses. Eleven patients in this group underwent colectomy and ileostomy, but in 10 the arthritis continued unabated postoperatively.

Rheumatoid spondylitis was present in 28 patients (5%), 20 of the group being males. In only 4 patients was there any correlation between spondylitic manifestations and activity of the colitis, and only 3 of the 15 patients receiving surgery showed any abatement of symptoms following surgery.

Peripheral joint arthralgias were present in 23 cases (4.2%). In 20 cases arthralgias paralleled the course of the colitis, and only one patient out of 15 receiving surgery failed to show relief of symptoms.

Lesions of erythema nodosum occurred in 16 patients (2.8%). In every case associated arthralgia or acute arthritis was present—usually of knees or ankles, or both. In 14 patients erythema nodosum paralleled the activity of colitis, and colectomy and ileostomy were successful in all cases (9 patients) in preventing recurrence of the lesions.

A group of 10 patients (1.8%) presented articular manifestations that could not be included in the previous categories. Swollen joints were present in all, but three features distinguished them from the others. (1) Articular swelling occurred simultaneously with the first attack of colitis in 6 patients and with subsequent attacks in 3. (2) In all cases articular manifestations were completely absent during periods of quiescence of the colitis

and following colectomy and ileostomy— which all received—none of the patients suffered recurrence of articular manifestations. (3) In this group only large joints were involved.

English and American literature contains few references to the articular manifestations of chronic ulcerative colitis, and then only as "arthritis" or "arthralgias." Only recently has an attempt been made to define criteria for the diagnosis of rheumatoid arthritis. The application of current nomenclature cannot be precisely applied to this study, but it is clear that the foregoing are five types of articular manifestations of chronic ulcerative colitis.

The frequency of articular manifestations in chronic ulcerative colitis has been stated to vary from 4 to 20%. Strict comparison of the present study with previous ones is not possible because of the ambiguity in terminology that has existed. The prevalenceof articular manifestations reported by the author was 17%.

In the present study, rheumatoid spondylitis was the most frequent articular manifestation which was a surprising observation because only recent mention of this relationship has appeared in the literature of the English language. The ratio of men to women in the present series was less than 3: 1—a much lower ratio than is usually associated with rheumatoid spondylitis. These findings suggest that this form of arthritis should be carefully looked for in all cases of chronic ulcerative colitis associated with back pain or peripheral joint symptoms.

The frequency of the other joint manifestations of this series showed no great variation from frequency rates reported by other observers.

In evaluating the relationship between the clinical course of joint manifestations and disease of the colon the author concludes that there is no close association between the course of rheumatoid spondylitis and chronic ulcerative colitis, and that rheumatoid spondylitis per se is not an indication for colectomy since its remission after this procedure is most unlikely. Arthralgias were closely related to colitis in this series, and colectomy resulted in total disappearance of the arthralgias in almost every case. However, since they are not in themselves severe or crippling forms of disease, their presence alone is not an indication for colectomy in cases of chronic ulcerative colitis.

A positive correlation is made between the course of rheumatoid arthritis and colitis in 44%, although with one exception, colectomy did not result in remission. Therefore, the concurrent presence of rheumatoid arthritis is not an indication for colectomy.

Erythema nodosum appears to be closely related to the activity of the colitis, and in this series remission always followed colectomy. However, unless the erythema nodosum is particularly severe its occurrence should not constitute an indication for colectomy.

"Acute toxic arthritis" presents a close relation to the activity of colitis, with colectomy seemingly effecting a cure. Under these circumstances, surgery would seem to be indicated.

The question of whether the articular manifestations of chronic ulcerative colitis are secondary to the colitis, unrelated, or part of the same disease can be answered only when a clearer understanding of the etiology and epidemiology of arthritides in general and chronic ulcerative colitis is established. Some observers believe that histologically synovial lesions in chronic ulcerative colitis are indistinguishable from those of rheumatoid arthritis. At this time, not enough is known about the significance of serologic tests to base a classification on their results. In the present series, latex-fixation tests generally gave positive results in the patients who had colitis and rheumatoid arthritis, and negative results in those with colitis and spondylitis or arthralgias. This result is in general agreement with findings in the cases of uncomplicated arthritides.

An interesting view has been expressed by Grey who wonders whether chronic ulcerative colitis might not belong to the family of "collagen" diseases. Others have made much the same conjecture. On the basis of the present study, the author agrees with Bargen who stated that "whether or not the arthritis should be called a complication or an associated disease is a debatable question." (Fernandez-Herlihy, L., The Articular Manifestations of Chronic Ulcerative Colitis - An Analysis of 555 Cases: New England J. Med., 261: 259-263, August 6, 1959)

* * * * * *

Chemical Therapy of Tumors

Although chemical agents capable of curing human cancer are not yet available, significant achievement in suppressive chemotherapy has been made.

A number of general approaches have been employed in the development of agents for use in cancer chemotherapy. If a metabolic pathway can be found that is sufficiently unusual for tumor cells, it should be possible to fashion an appropriate inhibitor of the pathway.

The classes of drugs currently used in cancer chemotherapy include hormones, antibiotics, alkylating agents, and antimetabolites.

The demonstration by Huggins of the effectiveness of diethylstilbesterol in prostatic carcinoma was the first evidence that a synthetic compound of known chemical structure could influence the growth of a human neoplasm. Agents of this sort are effective in inducing regressions in tumors which are hormone dependent; thus, their effectiveness is limited to a few tissues and to a few tumors of those tissues.

The use of cortisone, related steroids, or cortocotrophin in the treatment of the acute leukemias of childhood would appear to be an example of another principle of hormone therapy in cancer, but the mechanism of suppression of leukemic cells or normal lymphocytes by these steroids is

unknown. Relatively shorter remission is experienced with this agent than with other chemotherapeutic agents, although a more prompt response is obtained. Therefore, combined therapy is employed.

Bacterial toxins were among the earliest agents said to be of use in the chemotherapy of cancer and the effectiveness of antibacterial antibiotics has served to focus attention on the study of antibiotics as inhibitors of tumor growth. Temporary regression has been observed in some human tumors following treatment with Actinomycin D. Another antibiotic derived from streptomyces, Mitomycin C, has been reported to have induced tumor regression in patients treated in Japan.

The agents most generally useful in the chemotherapy of cancer in experimental animals as well as in man are the alkylating agents and the antimetabolites. The antitumor effects of these compounds have been correlated with effects on the biosynthesis of the nucleic acid purines. The development of folic acid antagonists represented the first useful application of the antimetabolite principle to cancer chemotherapy.

In children with acute leukemia, clinical and hematologic evidence of remission has been reported in 20 to 70% of patients after 3 to 8 weeks of treatment with folic acid antagonists. Complete remission has been observed in 20 to 30% of children treated. Amethopterin is the folic acid antagonist in most general current use.

The literature reported that the 50% survival time in children with untreated leukemia was 4 months. This figure was doubled following the advent of the folic acid antagonists and steroid hormones. The percentage of patients surviving longer than one year was 5% prior to the development of these two forms of therapy and 24% thereafter. Recently, folic acid antagonists have been reported to induce remissions in certain cases of lymphosarcoma in childhood.

The synthesis of 6-mercaptopurine represented part of a continuing study of purine metabolism and its inhibition as an approach to cancer therapy. The mechanism of action is not known, but incorporation into nucleic acids of viscera of mice and leukemic cells in man has been observed. Clinical and hematologic remissions have been achieved in approximately 50% of pediatric patients treated with this agent alone, and the percentage of patients surviving longer than one year has been increased to 52%.

The most recent addition to the list of antimetabolites of interest in cancer chemotherapy resulted from the synthesis of 5-fluorouracil and 5-fluoroorotic acid. The details of their utilization in the formation of nucleic acids have not been defined. Clinical trials have been reported and striking regressions have been observed in some solid tumors. Serious undesirable effects have been observed and attempts are in progress to alter the biologic properties of the compounds.

The other general class of compounds useful in cancer chemotherapy is that of the alkylating agents. Experience during World War I revealed

profound toxic effect on lymphoid tissue of nitrogen mustards. Experiments with these agents constituted the first demonstration that it was possible for a synthetic compound to induce regression in human tumors arising from tissues not under endocrine control. Only a few tumors or types of tumors are affected by this agent and the therapeutic index is low. These considerations have led to a search for similar agents which might possess greater activity and lower toxicity or selectivity of penetration.

Search for chemotherapeutic agents among derivatives of ethylenimine was suggested by the fact that the initial reaction of the aliphatic nitrogen mustards in water is the loss of chloride with the formation of cyclic ethylenimonium ion. Among the first of these compounds to be employed in cancer chemotherapy was triethylene melamine (TEM). A large series of similar compounds has been formed, with the principal advantage that they may be given orally. Variations of the chemical formula have resulted in Myleran—toxic to granulocytes—which has been used effectively in the treatment of chronic granulocytic leukemia; and Chlorambucil and Leukeran—toxic to circulating lymphocytes—effective against chronic lymphatic leukemia.

One of the more recent developments in the area of antimetabolites and alkylating agents has been the synthesis of compounds designed to be at the same time alkylating agents and structural analogues of important intermediate products of cellular metabolism. In these compounds the intermediate substance might serve as a carrier for the cytotoxic agent, providing some selectivity of entry into particular areas of certain cells. Observations indicate that amino acids might be appropriate carrier structures, and the possibility is suggested that greater specificity of antitumor action might be achieved by the preparation of cytotoxic derivatives of molecules such as peptides or proteins.

The synthesis of alanine and phenylalanine mustards represented the first example of the deliberate addition of a cytotoxic alkylating group to an amino acid residue. Reports from a number of laboratories provide encouragement that a new avenue of therapy may be opening up. Added to a growing group of the amino acid mustards is Aminochlorambucil with increased toxicity for lymphocytes; a nitrogen mustard derivative of serine with an improved therapeutic index and low toxicity; mustard derivatives of sugars developed in Hungary; and benzimidazole and pyrimidine combinations. An interesting and potentially valuable asset of sugar compounds is their ability to prevent development of metastatic implants. Experiments suggest the use of this agent to prevent metastatic spread at operations.

Although chemotherapeutic inroads into the problem of human neoplastic disease have as yet been small, these observations should serve as a stimulus for further definition of the metabolism of neoplastic cells and of the mechanisms by which available agents exert their cytotoxic effects. (Nyhan, W. L., Approaches to the Chemical Therapy of Tumors: J. Pediat., 55: 337-354, September 1959)

Anemia of Rheumatoid Arthritis

The anemia of rheumatoid arthritis has attracted the attention of investigators for many years, but its pathogenesis has remained elusive. All studies indicate that anemia is a frequent finding, reflecting the clinical activity of the disease. Disturbances in iron metabolism have also been noted. In all other respects the reported data are in marked disagreement. In earlier work on this problem the importance of erythrocyte suppression as the basic mechanism in the pathogenesis of this anemia was usually stressed. These conclusions were reached chiefly on the basis of evaluation of the appearance of the bone marrow aspirate. However, in a recent study, the utilization of intravenously injected tracer doses of iron for hemoglobin synthesis was normal. Evidence for overt hemolysis in the anemia associated with rheumatoid arthritis has been contradictory and not impressive.

The most marked area of disagreement is in regard to the cause and relative importance of the disturbances in iron metabolism. Like most anemias associated with inflammation, the anemia of rheumatoid arthritis is often hypochromic. Similarly, there is a moderate reduction in the serum iron level, but often the reported effects of iron therapy have not been consistent. Recently it has been suggested that the disturbances in iron metabolism may be the result of failure to mobilize iron from the reticuloendothelial cells.

Making detailed studies on 18 patients with rheumatoid arthritis and comparing results with a series of control patients, the author's findings confirm the common observation that the anemia of rheumatoid arthritis reflects the activity of the disease, and that moderate degrees of hypoferremia are noted in most of the cases. A slight degree of hypochromia was noted in the peripheral blood smear of these patients. However, calculation of the mean corpuscular hemoglobin concentration revealed no significant deviation from the normal. The patients of this series had normal to low iron-binding capacities, normal absorption of iron from the gastrointestinal tract, and ample to increased iron stores in the bone marrow—all observations indicating that the anemia was not that of iron deficiency in the usual sense. Furthermore, parenteral iron appeared to be of no benefit.

Increased plasma volumes were found in some cases, although for various reasons the author did not consider the observations totally valid and was unable to explain the phenomenon. Shortening of red cell survival and abnormalities in iron metabolism were noted and were considered significant in the pathogenesis of the anemia, the former indicating a process of hyperhemolysis. Patients with atypical rheumatoid arthritis tended to have a greater degree of red cell destruction than those patients with a more classic form of the disease—particularly those with splenomegaly. The magnitude of increased red cell destruction in itself was not considered to be responsible for any developed anemia, possibly indicating some inappropriate bone marrow response or a defect in the availability of iron from

the senescent red cells and defect in mobilization of iron from the reticuloendothelial cells. In the patients studied, intravenous radioiron was employed for erythrocyte production in a normal manner.

Although the occurrence of anemia with rheumatoid arthritis is a well established fact, the author suspects the possibility of complications when the degree of anemia is severe. These include superimposed iron deficiency due to blood loss, the development of the malignant phase of rheumatoid arthritis, the presence of congestive splenomegaly, or the presence of underlying disseminated lupus erythematosus rather than rheumatoid arthritis. (Weinstein, I.M., A Correlative Study of the Erythrokinetics and Disturbances in Iron Metabolism Associated with the Anemia of Rheumatoid Arthritis: Blood, XIV: 950-964, August 1959)

* * * * * *

Griseofulvin - an Oral Antibiotic for Ringworm

Superficial fungous infections have plagued man, animals, and plants since the dawn of time. Treatment has been partially effective against infection of the glabrous skin, largely ineffective against infection of the hair, and completely ineffective against infection of the nails.

The first significant advance in the direction of a specific systemic avenue of therapy was the discovery of nystatin, an antibiotic obtained from Streptomyces noursei, which was effective against yeast-like fungi (e.g., monilia) but not against the common dermatomycoses. The break-through in therapy was the discovery of griseofulvin, derived from several penicillia. To date, a limited number of reports are available in medical literature, but results tend to be encouraging.

Current consensus is that griseofulvin is a remarkably effective remedy for the common dermatomycoses which include those caused by the Microsporon, Trichophyton, and Epidermophyton varieties of fungi. It is not effective against tinea versicolor, candidiasis, moniliasis, thrush, or the deep fungous infections—blastomycosis, sporotrichosis, coccidioidomycosis, actinomycosis, histoplasmosis, et cetera.

Toxic reactions to administration were few and minor in nature. Some patients experienced headache or gastrointestinal distress during the first few days, but usually subsided on continued administration. An occasional patient developed an urticarial eruption which required discontinuation of the drug. Hematologic and visceral function tests showed no abnormalities attributable to griseofulvin. An interesting incidental observation was that some of the author's patients with a history of reactions to penicillin suffered no adverse reactions to penicillium-derived griseofulvin.

The usual adult dose is 1 gm. per day taken orally in 4 equal doses. Itching of cutaneous ringworm lesions ceases within 3 to 5 days, followed by

desquamanation and a temporary brownish discoloration, with clearing in about 3 weeks—longer with involvement of scalp ahd thicker layers of skin. New nail growth occurs at the nail root in 2 to 4 weeks, but treatment is continued until the entire nail-plate has grown out, requiring 4 to 6 months.

It is emphasized that griseofulvin is fungistatic, not fungicidal, and that treatment must be continued until the affected parts are both clinically and mycologically negative.

Intelligent use of griseofulvin is dependent upon a basic knowledge of both dermatology and mycology. All that is ringed is not ringworm, and all ringworm need not be ringed. Similarly, all scalp affections and nail distortions are not of fungal etiology.

Inevitably griseofulvin will be wrongly condemned as useless when used in dermatoses which are not due to fungous infection. The high cost of antibiotic medication should be a deterrent to casual and indiscriminate prescribing unless the diagnosis is certain. (Weiner, M. A., Gant, J. Q. Jr., Griseofulvin - an Oral Antibiotic for Ringworm of the Skin, Hair, and Nails. A Preliminary Report: Med. Ann., District of Columbia, XXVIII: 423-425, August 1959)

* * * * * *

Intraosseous Venography

Studies on portal hypertension have been focused upon anatomy, pathology, and altered hemodynamics of the portal venous bed. Newer radiologic and physiologic techniques have significantly advanced knowedge of the basic mechanisms involved in this condition.

From their experience with costal intraosseous venography, the authors present data and observations on the systemic venous collateral circulation in portal hypertension. This method consists of injecting contrast material directly into the medullary cavity of a rib.

Previous work has shown that such technique demonstrates venous pathways not outlined by conventional means. When radio-opaque material is injected into the marrow of a rib a fairly constant intrathoracic vascular pattern can be outlined in the normal subject. As a sequel, certain disease states are observed to produce rather constant alterations of the normal venous pattern.

Experience of the senior author with over 1,000 injections into a variety of bones including over 500 ribs resulted in the conclusion that the procedure is free of immediate or late ill effects if specified precautions are observed.

The venous pattern in patients with portal hypertension is distinctly different from that observed in the normal subject. A complicated and seemingly confusing network of venous channels may replace the normal simple

configuration. Abnormal systemic venous forms may be present even though esophageal varices are not demonstrable on esophagograms or by esophagoscopy. Various alterations in the systemic venous patterns are illustrated and tabulated.

The authors contend that the systemic venous pattern in portal hypertension is distinctly different from the ones produced by other intrathoracic disorders, such as by a superior vena cava syndrome or cardiac decompensation.

Costal intraosseous venography may prove to be a valuable tool in the evaluation of equivocal diagnostic problems with hepatomegaly and/or splenomegaly, and with acute upper gastrointestinal tract hemorrhage of obscure origin. The existence of portal hypertension would be improbable in the presence of a normal intrathoracic systemic venous pattern. Conversely, the roentgenographic demonstration of altered systemic venous hemodynamics, as observed in portal hypertension, would invite further diagnostic procedures in an effort to clarify the degree and type of hemodynamic alterations within the portal venous bed. (Schobinger, R., Cooper, P., Rousselot, L.M., Observations on the Systemic Venous Collateral Circulation in Portal Hypertension and Other Morbid States Within the Thorax: Ann. Surg., 150: 188-195, August 1959)

* * * * * *

Navy Authority on Space Medicine Retires

CAPT Norman L. Barr MC USN, one of the Navy's leading authorities on space medicine and, until recently, Director of the Astronautical Division, Bureau of Medicine and Surgery, was placed on the retired list 1 September 1959, closing a 21-year naval career. Prior to his commission in the Navy, CAPT Barr served in the U.S. Army Reserve for three years and spent over 9 years in the U.S. Army Air Force.

Born in Myrtlewood, Ala., in 1905, CAPT Barr studied medicine at Georgetown University Medical School, Washington, D. C., receiving his M.D. degree in 1937. He was appointed LTJG in the Medical Corps of the Navy on 16 July 1938; was designated naval flight surgeon in 1940; and through subsequent promotions attained the rank of captain in July 1954.

From 1943 to 1946 CAPT Barr served as medical officer, flight surgeon, and naval aviator on board various aircraft carriers and fleet activities. In 1946 he was assigned in the Bureau of Medicine and Surgery as Officer-in-Charge of Special Activities and Director of Project RAM (Research Aviation Medicine), a joint project of the Bureau of Medicine and Surgery and the Bureau of Aeronautics. In this assignment he was concerned with establishment of the Naval Acceleration Laboratory, Johnsville, Pa., the Space Orientation Laboratory, Pensacola, Fla., and research programs

in high altitude physiology and bio-physics. In 1950 he was assigned as Head, Aviation Medicine Division, Naval Medical Research Institute, Bethesda, Md. In 1956 he returned to the Bureau of Medicine and Surgery where he served as Deputy Director, Research Division, and later as Director, Astronautical Division.

CAPT Barr has compiled more than 12,000 hours in the air of which more than 8,000 have been as first pilot. He is the only known officer in the military service who is entitled to wear five separate Military Aviation Wings: Air Force Pilot, Air Force Observer, Air Force Flight Surgeon, Navy Flight Surgeon, and Naval Aviator.

Many of the accomplishments of the Navy's medical research program were developed during the time of CAPT Barr's association with them. While directing project RAM he developed a system which gathers physiologic information from pilots in the air as well as from animal and human occupants of earth-orbiting vehicles, transmits the information to the ground by radio, relays it to a central laboratory by radio and telephone from any part of the world, and records it automatically. In the present state of perfection, the equipment permits transmission of electrocardiogram, electroencephalogram, body temperature, skin temperature, respiratory rate, respiratory volume, and other physiologic determinations.

CAPT Barr is the author of many medical and scientific professional papers. He is a Fellow, Aero-Medical Association; member, Space Medicine Association; member, Association of Military Surgeons; Fellow, American College of Cardiology; Diplomate, American Board of Preventive Medicine in Aviation Medicine; and member, Alpha Omega Alpha medical honor society. (TIO, BuMed)

* * * * * *

From the Note Book

Foreign Officers Receive Navy Training. Twenty-three medical, dental and nurse military officers representing eleven allied countries, began post-graduate training at the U.S. Naval Medical School, National Naval Medical Center, Bethesda, Md., on 3 September 1959. The program, part of President Eisenhower's People-to-People Program and the Military Assistance Program of the Navy, includes Naval Medical Management, Dental Management, Preventive Medicine, and Orientation for Military Nurses. (News Release, NNMC)

U.S.N. Hospital Invitation. In a recent letter addressed to the Surgeon General, CAPT L.E. Bach MC USN, Commanding Officer, U.S. Naval Hospital, Camp Lejeune, N.C., stated: "We are making an effort to get all (Medical Department Personnel) attached to other commands to feel at home in our hospital and to feel that we are all on the same team. Last week I had

the first meeting and luncheon with all the senior Medical officers of other activities at Camp Lejeune. Everyone expressed pleasure at being able to attend and a desire that such meetings continue. They will be held at monthly intervals. I believe these meetings will be a great help in solving mutual problems as well as providing an opportunity to meet occasionally with some very fine colleagues."

Exhibition Cited. The Hospital Administration Division of the Bureau of Medicine and Surgery participated in the presentation of a Federal Hospital Exhibit at the recent American Hospital Association meeting in New York City. This exhibit, one of 50 education exhibits, was selected as the best of its classification. The panel from the Bureau, which dealt with Work Simplification applied particularly to linen procedures, was well received. (TIO, BuMed)

Cows, Horses—and Krebiozen. From the Executive Director's News Letter of the September GP comes this terse book review: "Herbert Bailey's book, 'A Matter of Life or Death,' is another impassioned plea for Krebiozen. . . . Bailey . . . unwittingly uses himself to show how an uninformed layman can be euchred into blind allegiance by not knowing how to tell facts from fiction. . . . According to Bailey, the answer came to Dr. Steven Durovic as 'the fair rich fields of his family's ancestral estate rolled before his mind's eye and he saw again the family herds of cows and horses. What else is there to say?"

Sports Injuries. The September issue of the American Journal of Surgery is devoted to an extensive symposium on Sports Injuries with 26 articles covering the topic from Physical Fitness for Sports, Athletics and Nutrition, and The Place of the Trainer in Modern Athletics, to a series of discussions of management of injuries of specific anatomical regions.

Bleeding Duodenal Ulcer. From a study of 162 consecutive cases of bleeding duodenal ulcer at U.S. Naval Hospital, Philadelphia, the authors conclude that greater stress should be placed on pain patterns. The "silent bleeder" would be the patient demanding more vigorous therapeutic measures. Various other factors in relationship to bleeding were detailed and discussed. (LT Jay Desjardins MC USN, et al., J.A.M.A., 29 August 1959)

Pituitary Tumor. Twelve of a series of 122 patients with adrenal hyperplasia and Cushing's syndrome studied at the Mayo Clinic had clinical or histologic evidence of pituitary tumor. Six of the 12 patients had ocular abnormalities. The incongruous homonymous nature of the field defects and the involvement of the third nerve indicated parasellar extension of the tumor. From these observations it appears that roentgenographic study of the sella, ophthalmoscopic examination, and plotting of visual fields should be routine in the initial

examination and subsequent evaluation of patients who have Cushing's syndrome. (T.P. Kearns, et al., A.M.A. Arch. Ophth., August 1959)

Tibial Stress Fractures. Analyzing 35 cases of stress fractures of the tibia from the U.S. Naval Hospital, Camp Pendleton, Calif., the author stresses the importance of the lesion in the differential diagnosis between bone tumor, osteomyelitis, and thrombophlebitis. The insidious development of symptoms combined with delayed x-ray evidence of pathology contribute to possible confusion in diagnosis of the typical case. (J. Benedict, J. Internat. Coll. Surgeons, August 1959)

Intravenous Fat Emulsion. The authors studied the effect of an intravenous fat emulsion on blood coagulation, observing that hypocoagulability of the blood occurred in most patients and severe hemorrhage occurred in 3 of 20 patients. The condition reverted to normal without treatment other than whole blood transfusion which was required in three instances. Hypocoagulability may develop from fat emulsion given intravenously when more than 500 ml. per day is given for a period longer than 14 successive days. (J.A. Werr, F.W. Preston, A.M.A. Arch. Surg., August 1959)

Carcinoma of the Thyroid. Noting an increase of frequency of carcinoma of the thyroid during the past 5 years, the author stresses that surgery should be performed on all children with nodular goiter, men with nontoxic nodular goiter, and all patients with discrete or solitary tumor. The type and extent of operation should be governed by immediate frozen section determination of the type of growth present. Radioactive iodine has been of use in locating metastases and, to a limited extent, in treatment. (R. Ward, J. Internat. Coll. Surgeons, August 1959)

Deaths from Bites and Stings. Of 215 deaths during 1950 - 1954 due to bites and stings of venomous animals, insects (Hymenoptera—bees, wasps, hornets, yellow jackets, and ants) killed more (40%) than venomous snakes (33%). Rattlesnakes were the most dangerous venomous animals, accounting for 55 deaths, while bees were next most deadly, taking 52 human lives. (H.M. Parrish, A.M.A. Arch. Int. Med., August 1959)

Vascular Brain Syndromes. In anatomical drawing, tabulation, and diagram, schematic representation of the vascular supply of the brain and of the cranial nuclei is presented, which is considered an excellent aid in the diagnosis of occlusive vascular lesions of the brain and brain stem. (M. Holtzman, et al., Am. J. Phys. Med., August 1959)

Gastric Acid Rebound. From review of recent literature and their own studies, the authors consider that there is no support for the commonly held assumption

that there is an "acid rebound" phenomenon in response to alkali ingestion. (J. Pereira-Lima, M. D., F. Hollander, Ph. D., Gastroenterology, August 1959)

* * * * * *

BUMED INSTRUCTION 1500.4B 21 August 1959

From: Chief, Bureau of Medicine and Surgery
To: Ships and Stations Having Medical Corps/Dental Corps Personnel

Subj: Professional examinations and memberships in civilian professional societies for Medical and Dental officers; reporting of

This instruction informs Medical and Dental officers of the requirement for furnishing the Bureau of Medicine and Surgery information relative to professional examinations and memberships in civilian professional societies.

* * * * * *

BUPERS INSTRUCTION 1120.15D 10 September 1959

From: Chief of Naval Personnel
Commandant of the Marine Corps
To: All Ships and Stations

Subj: Permanent and temporary appointment in the Medical Service Corps, Regular Navy; inservice procurement programs for

This instruction consolidates two prior directives (BuPersInst 1120.8A and BuPersInst 1120.15C) thereby establishing a uniform procedure for the processing of applications from qualified men and women on active duty for appointment in the various sections of the Medical Service Corps, U.S. Navy.

As a result of the warrant officer phase-out program, this directive initiates procurement of temporary officers as a replacement for the Medical and Dental warrant input. It is emphasized that this replacement concerns initial appointments only. It does not mean replacement of existing warrant officers. Temporary appointments in the Supply and Administration Section may be tendered up to the maximum age of 35 years as of 1 July of the year in which the appointment can first be made.

Commanding Officers are requested to disseminate the content of this instruction to insure that all eligible personnel are cognizant of its provisions.

* * * * * *

DENTAL SECTION

Message from the Chief of the Dental Division

"To all Navy Dental Personnel:

This letter is to express my sincere appreciation to all of you who, on August 22, so wholeheartedly supported the commemoration of the Forty-Seventh Anniversary of the founding of the U.S. Navy Dental Corps. Many excellent reports of your successful affairs have reached this Bureau through copies of ships' and stations' publications and civilian newspapers. The articles in these publications were uniformly in good taste and can result only in enhanced public respect for our profession and the Navy. I am confident that the birthday celebration contributed significantly to the solidarity and esprit de corps of our organization.

I am happy to report that the ceremonies, receptions, and news articles were so numerous this year that it is not practicable to send individual letters of appreciation to the heads of dental facilities who sponsored commemorative activities. I am pleased that your enthusiastic support in recognizing the anniversary of our Corps has made it necessary for me to use an open letter to express to you this

Well Done -
/s/
C. W. SCHANTZ"

* * * * * *

Response to Implants of Anorganic Bone

While initial host acceptance of anorganic bone implants has been demonstrated previously, the ultimate fate of these osseous grafts has not been observed. A long-term histologic evaluation of anorganic bone implants in man was undertaken to parallel similar animal studies currently being made.

Implants of anorganic bovine bone were placed in oral bony defects of human patients. These defects had resulted from the destruction of alveolar bone by commonly occurring periapical and periodontal pathologic lesions and from loss of osseous structure attending complicated exodontia. The postoperative course was uniformly uneventful.

Biopsies of the implanted defects, from 3 to 18 months postoperatively, were obtained in 15 cases. Histologic evaluation of these specimens revealed a general lack of significant inflammatory response surrounding the anorganic particles. At the periphery of the defects the anorganic particles were being remodeled by reactive-appositional bone growth. There was a general lack of osteogenic activity around anorganic particles which were not in intimate contact with the host bone. Implanted particles lying immediately beneath the mucoperiosteum or in the central portion of the defect were, in general, surrounded by fibrous connective tissue. In some defects, in which attempts had been made to restore alveolar contour and height, the labial and buccal cortices had reformed, engulfing anorganic particles in the newly formed matrix. However, osteoblastic and osteoclastic activity at the periphery of these particles was minimal. Persistence of implanted anorganic particles over prolonged periods of time postoperatively and general long-term histologic status of the implants would tend to indicate the limitations in the clinical use of this material. (P. J. Boyne, Marine Corps Base, California, H. W. Lyon, Dental Division, Naval Medical Research Institute, Bethesda, Maryland: Journal of Dental Research, S-15, July - August 1959)

* * * * * *

New Correspondence Extension Course

A correspondence extension course in oral diagnosis (Oral Diagnosis, NavPers 10739) is available to officers of the Dental Corps of the U. S. Navy and Naval Reserve. The course was developed by the staff of the U. S. Naval Dental School, National Naval Medical Center, Bethesda, Md., with the assistance of professional test constructors of the Home-Study Department of the University of Chicago.

Reserve Dental officers may receive promotion and/or retirement points to be credited at the completion of course units. The first unit of the course, "Oral Diagnosis," is comprised of assignments 1 through 6 and is evaluated at 12 points; the second unit consists of assignments 7 through 10 and is evaluated at 6 points. These points are creditable only to personnel eligible to receive them under current directives governing retirement and/or promotion of Naval Reserve personnel.

This is the third of a group of postgraduate level extension courses being prepared under the auspices of the Naval Dental School to augment the continuing education program for officers of the Navy Dental Corps. The

courses previously prepared are Prosthodontics, Part II, Partial Denture Prosthesis, NavPers 10764 (Medical News Letter, 7 November 1958), and Endodontics, NavPers 10407 (announced in Medical News Letter of 3 July 1959).

"Oral Diagnosis" is comprised of ten assignments covering the philosophy of treatment planning, special methods of examination, special diagnosis of dental and oral diseases, and suggested treatment procedures.

Not specified in the original description of the course, it is announced that nine promotion and/or retirement points will be credited to Reserve Dental officers completing the extension course in Endodontics (NavPers 10407) which consists of three assignments.

Applications for enrollment in these courses should be submitted on NavPers 992, Application for Enrollment in Officer Correspondence Course, via official channels, changing the "To" line to read: Commanding Officer (Code 5), U.S. Naval Dental School, National Naval Medical Center, Bethesda 14, Md.

* * * * * *

Newly Standardized Dental Item

A newly standardized periosteal elevator has been made available through regular supply channels. Information pertaining to the new item is:

Stock Number	Item Description	Unit Price
FSN 6250-584-2699	Elevator, Periosteal, Molt, No. 9; double ended	$2.90

* * * * * *

Technician Training in Maxillofacial Prosthesis

Applications are desired for training in Maxillofacial Prosthesis. Dental Technicians in the rates of DT1 and DT2 with a primary Navy Enlisted Classification of 8752 and in the third segment of the SEAVEY (October 1959) are encouraged to submit requests. Applications must be submitted in accordance with BuMed Instruction 1510.2B. Preference will be given to those Dental Technicians who have completed 4 years of active naval service.

* * * * * *

RESERVE SECTION

Tables of Organization for Naval Reserve, Fiscal Year 1960 BuPers Instruction 5400.1H, 1 July 1959

(Continued from Medical News Letter, 18 September 1959)

4. Equivalent Duty. Equivalent duty shall be approved and conducted in accordance with the instructions contained in Article H-4206 of the BuPers Manual. The scheduling of equivalent duty is discretionary with unit commanding officers. Equivalent drills may be performed only in the quarter in which the regular drills being made up were missed, except that regular drills missed in the final month of any quarter may be made up in the first month of the next quarter if circumstances prevent make-up during the month in which missed. The maximum number of periods of equivalent instruction or duty that may be performed by individual members of the various programs are:

Max. No. Regular Drills Authorized Annually	Maximum No. of Periods, Authorized Equivalent Duty			
	Per Annum	Per Quarter	Per Month	Per Week
48	8	4	2	2
36	6	3	2	2
24	4	2	2	2

5. Appropriate Duty.

a. The purpose of appropriate duty is to permit the commandants to accomplish certain tasks and functions which are in support of the Naval Reserve and the Marine Corps Reserve. In addition, appropriate duty may permit commandants to accomplish tasks in support of the Naval Service generally, and to authorize special categories of training for individual Naval Reservists.

b. Commandants are authorized to issue appropriate duty orders to individuals of the Naval Reserve not on active duty who are qualified to perform the duties required of them by such orders. It is the responsibility of the commandant to determine that appropriate duty performed is of substantial benefit to the Navy generally, and to exercise close supervision over the performance of appropriate duty.

c. Categories of Appropriate Duty Authorized.

(1) Appropriate duty orders may be issued for the performance of tasks in support of Selected Reserve and Marine Corps Reserve as follows:

(a) To 2105, 2205, and 2905 officers for the performance of medical and dental examinations, and essential services of an administrative nature for Naval Reserve or Marine Corps Reserve units;

(b) To 3105 officers for assisting Naval Reserve Training Centers in the procurement, handling, and issuance of clothing and small stores, the preparation of necessary vouchers for disbursing officers and in other supply and fiscal matters where such assistance is not available through active duty support personnel or inactive duty personnel attached to, or associated in pay status with, drilling units supported by the Training Center concerned;

(c) To 4105 officers for assisting Naval Reserve and Marine Corps Reserve training activities in providing spiritual, moral, and temporal welfare support to members of Naval or Marine Corps Reserve units. (Chaplains selected for this duty with pay must either have served on active duty as chaplain, or have performed 2 weeks active duty for training as chaplain and have completed correspondence courses in Navy Regulations (NavPers 10704-A, and the Navy Chaplain, NavPers 10905-A).)

(d) To 5105 officers for the performance of duties similar to those performed by an officer of the Civil Engineer Corps assigned to a regular Navy activity as Public Works Officer, such duty to be for the benefit of Naval Reserve Training Centers which are located in areas not readily available to staff personnel assigned to the District Public Works Officer. (Areas which are outside a 50-mile radius of District Headquarters may be considered not readily available.)

(e) To individual Naval Reservists for acting as the Commandant's Local Representative to assist drilling unit commanding officers in the field of recruiting and procurement.

(f) To individual Naval Reservists who participate with drilling units of Selective Service Programs of other branches of the Armed Forces.

(2) Appropriate duty orders may be issued for the performance of the following tasks in support of the Naval Service generally:

(a) To 2105 and 2205 officers for duty as consultants at Naval Hospitals (Appointment of officers for this duty must be approved by the Commanding Officer of the Hospital concerned and by the Chief, Bureau of Medicine and Surgery.), and for the conduct of physical and dental examinations for members of the Naval Reserve. In this latter authorization, the completion of three physical examinations or five dental examinations shall constitute the basis for one appropriate duty credit.

(b) To individual Naval Reservists for representing the Commandant in local areas where he cannot be represented by suitable active duty personnel, such representation to include attendance at public ceremonies, matters concerned with legal duties, public relations, the administration of the Naval Reserve in a local community, recruiting, and procuring personnel for membership in drilling units.

(3) Appropriate duty orders may be issued for the performance of the following special categories of training:

(a) Attendance at symposiums, or other training or lecture programs conducted under the auspices of the Armed Forces; (Symposiums must be sponsored by, and under control of, the military and may be conducted in conjunction with professional or trade conventions. In this event, they must have received prior approval of the Bureau or Office concerned and the Chief of Naval Personnel.) Credit may be granted only when:

1. An individual participates in his capacity as a Reservist and devotes his time and effort beyond that normally associated with his civilian occupation.

2. Such activity is engaged in without remuneration other than pay to which he may be entitled as a member of a Reserve component.

3. Such activity demonstrably improves the individual's fitness to perform the military duties to which he may reasonably be expected to be assigned upon mobilization or similarly improves the fitness of others by his supervisory responsibilities on such an occasion.

(b) To individual Naval Reservists for participation in Naval Reserve Communication Networks.

(c) To individual Naval Reservists for participation with drilling units of the Selective Service Program.

d. Pay Status. Pay status may be authorized in orders issued to Ready Reserve or Marine Corps Reserve units not to exceed 48 periods per year. The number of orders so issued will not exceed the quotas established in Table 26. Pay status will not be authorized for other categories of duty. Appropriate duty orders without pay may be issued to Ready or Standby (Active) Reservists for all purposes listed in paragraph 5. c.

e. Limitations

(1) Appropriate duty orders may be issued to members of drilling units of all programs only for purposes set forth in paragraph 5. c. (2) and (3) (a) and (b) above.

(2) In the event qualified officers are not available in a given locality for the performance of a support task, then fully qualified commissioned warrant officers, warrant officers, or enlisted personnel may be issued orders.

(3) Orders issued for the performance of a task in support of the Naval Service generally or special categories of training may indicate termination of the orders on completion of specific duties or may be on a permanent, continuing basis.

(4) Credits for any purpose for the performance of appropriate duty will not exceed the following numbers of periods:

Annually ... 48	Monthly... 6
Quarterly .. 13	Weekly ... 2
Daily 2	

If two periods of appropriate duty are performed in one day, then each period will consist of duty of not less than 4 hours' duration.

f. Reports of Performance of Duty. Individuals under appropriate duty with pay orders will report and certify their performance of such duty monthly in letter form to the Commandant concerned, via the Commanding Officer or Officer in Charge of the military activity, if any, to which the Reservist has been directed to report. Individuals under appropriate duty without pay orders will make a similar report and certification quarterly to the Commandant. However, the attendance of personnel attending approved symposiums or other training or lecture programs may be reported in composite letter form directly to the Officer in Charge, Reserve Officers Recording Activity with copies to the Chief of Naval Personnel and Commandant concerned.

g. Content of Orders. In addition to the requirements of the BuPers Manual, Article H-4207 (2) (a), appropriate duty orders will stipulate:

(1) That the orders are subject to the consent of the Reservist concerned;

(2) That acceptance of the orders by performance of duty under them subjects the Reservist to the Provisions of the Uniform Code of Military Justice;

(3) The military command, if any, to which the Reservist will report in compliance with the orders.

NOTE: Additional excerpts from this important Instruction will be published in succeeding issues of the Medical News Letter.

* * * * * *

Comments We Like to Read

The following letter from a member of the Navy's Ensign Medical Program was written to LCDR Matthias H. Backer, Jr., MC USNR, Commandant's Representative and member of the faculty of St. Louis University School of Medicine. The writer, ENS Fred C. Leisse 1915 USNR, a fourth-year medical student at the above University, is currently enrolled in the Navy's Senior Medical Student Program and participated in last summer's NROTC Midshipmen Cruises. His comments concerning his experiences at sea are considered worthy of reprint and are published here with the permission of the writer.

July 17, 1959

"Dear Dr. Backer -

I want to thank you for everything you did in helping me get this cruise. It has been wonderful. I've seen the real Navy, and I like it. I have had experiences which I may never realize again, and they have been great. I have been thrown into the company of men who are some

of the finest I've ever met. I've been accepted as an equal by men who are without a doubt the backbone of this country, and a strong backbone it is.

At present I am aboard the destroyer U.S.S. DAMATO, spending a few days to see what the practice of medicine is like aboard a small ship. Until yesterday the U.S.S. RANDOLPH was my ship. It is one of the largest carriers, angle deck and all. I was high-lined over here during refueling, which was quite an experience. I also had the thrill of being catapulted off the carrier in one of the anti-sub planes, got to fly it for about half an hour, and then landed again on the flight deck. The catapult shot was really something.

We had 6 days liberty in New York over the 4th. My girl was waiting for me on the pier and we had a wonderful time together. Right now we are off the coast of Newfoundland, and will arrive in Quebec on July 20 for a week's liberty.

I've seen every phase of these ships in operation, and if my movies turn out well, we should really have some propaganda material for next year. Keep your fingers crossed.

I hope to return to the carrier Sunday by helicopter so that I can get ready for Quebec where everything indicates that we'll get the red carpet treatment. I want to thank you again for everything, and though this letter is short, I hope you realize how long I am on appreciation for all you've done for me.

I hope you and your family are well. I'll see you back in old St. Louis. Until then, I am

Sincerely yours,
/s/
RICK LEISSE"

* * * * * *

Change of Address

Please forward requests for change of address for the News Letter to: Commanding Officer, U.S. Naval Medical School, National Naval Medical Center, Bethesda 14, Md., giving full name, rank, corps, and old and new addresses.

* * * * * *

Use of funds for printing this publication has been approved by the Director of the Bureau of the Budget, 19 June 1958.

* * * * * *

OCCUPATIONAL MEDICINE

Occupational Health Congress in New York

The 13th International Congress on Occupational Health will be held 25 - 29 July 1960 in the Hotel Waldorf-Astoria, New York City. It is being organized under the auspices of the International Association on Occupational Health. The program will include physicians, nurses, and industrial hygienists representing more than 40 countries. The following phases on occupational health will be considered: administrative methods, medical and surgical practices, education and training, social and legal aspects, work physiology and psychology, environmental factors in health, environmental hygiene, and hazards of specific industries.

Naval Medical officers engaged in the practice of Occupational Medicine and Naval Industrial hygienists, both military and civilian, are strongly urged to present papers in their respective fields of endeavor at this Congress.

Information may be obtained from Dr. Irving R. Tabershaw, Chairman, Scientific Program Committee, International Congress on Occupational Health, 375 Park Ave., New York City.

* * * * * *

Radiation as an Industrial Medical Problem

Radiation was an industrial health problem long before nuclear reactors and atomic bombs became a reality. Therefore, it is not exactly accurate to equate the coming of atomic energy with the introduction of radiation as an industrial health problem. It is true that only with the successful development of the nuclear reactor did available sources of radioactivity cease to be a few curies and grow quickly to millions of curies. This is the reason why the radiation hazards of the nuclear age are potentially greater by orders of magnitude than in prior years and why Dr. Detlev W. Bronk, in his foreword to the 1956 NAS-NRC Summary Report, "The Biological Hazards of Atomic Radiation," was justified in saying:

"The use of atomic energy is perhaps one of the few major technological developments of the past 50 years in which careful consideration of the relationship of a new technology to the needs and welfare of human beings has kept pace with its development. Almost from the very beginning of the days of the Manhattan Project careful attention has been given to the biological and medical aspects of the subject. By contrast, the automobile revolutionized our pattern of living and working, but we are only now beginning to appreciate the problems of safety, urban congestion, nervous tension, and atmospheric pollution which have accompanied its development."

The most characteristic feature of radiation as a day-to-day industrial health problem is the long latent period which elapses between exposure or beginning exposure and the first appearance of clinical or laboratory evidence of injury. In general, the lower the exposure or exposure rate the later resulting injury manifests itself. Usually, years intervene before malignant change appears. Any genetic effects would appear in succeeding generations and probably be demonstrable only on a statistical basis. Acute injuries have occurred and will be a continuing threat so long as nuclear energy continues to be exploited for the benefit of society or as a weapon of war. Industrial physicians must learn how to deal with such eventualities, but in their day-to-day contact with radiation problems they will be concerned principally with prevention of over-exposure to radiation and care of the less dramatic injuries involving radiation, such as localized skin burns and wounds contaminated with radioactive materials.

First knowledge of the carcinogenic action of radiation exposure was acquired in 1902, only 7 years after x-rays were discovered. Ionizing radiations in very large total doses, probably of the order of several thousand roentgens to the skin, were observed to have caused skin cancer. During the next two decades cases of radiation-induced skin cancer among physicists and radiologists appeared and were related to exposures incurred during their work as scientists, but it was not until the middle 20's that radiation was clearly established as an industrial health hazard in the usual sense of the word.

In 1935 Martland reported an outbreak of cases of osteitis, anemia, and bone cancer in young women, all employed in the watch dial industry. This study has become a classic in what might be called radioepidemiology. Meanwhile, it was known that in Czechoslovakia in pitchblende mines which had been worked for centuries for a variety of minerals, death from pulmonary disease was the rule. By 1913 it was established that a prime cause of death in these workers was lung cancer, and in 1942 it was established that the atmosphere of the mines contained considerable concentrations of radon gas, probably great enough to be the causative agent for the lung cancers.

In 1927 Muller established that roentgen irradiation of germ cells of the fruit fly resulted in gene mutations. In the 1930's it was established

that whole-body irradiation in single or divided doses was leukemogenic in mice. By 1940, except for the effects of whole-body radiation exposure on average life span, the general nature of hazards inherent in working with radiation and radiation sources was known although poorly quantitated.

Beginning in 1929 a group which later became the National Committee on Radiation Protection and Measurement began cooperating with the International Commission on Radiological Protection in developing recommendations concerning the maximum permissible exposure of the relatively few adult workers who were then using x-ray machines and radium and, later, other sources of ionizing radiation. In 1950 the recommendation was 0.3 r per week or 15 r per year, and in 1957 the average annual permissible exposure was set at 5 r. (The present average permissible exposure allows 0.3 r/week, but not more than 3 r/quarter and not more than an average of 5 r/year.)

It is interesting to see how the picture looked at the time to those responsible for the health of the workers on the atomic bomb project:

> Early in 1942 scientists of the Metallurgical Laboratory became convinced that a nuclear chain-reacting pile could be built. They realized the enormity of the health hazards that such a unit would create. Some of them had friends or acquaintances who had been injured in experimental work with x-rays or with radium, and many were aware of the harmful effects suffered by some workers in the radium-dial industry.
>
> Since no one person could have all the required knowledge or could know how to acquire it, a health group was formed which gradually evolved into an organized Health Division. The objectives of the Health Division as stated by the Laboratory Director were:
>
> 1. Protection of the health of the workers on the project.
> 2. Protection of the public from hazards arising from the operation of the project.
> 3. A study of the peculiar hazards for the purpose of being better able to establish tolerance doses, to predict more accurately what might happen in the future, to devise means of detecting ill effects to personnel, and to discover methods of treating any person who might be injured.
>
> A broadly conceived research program was initiated to study the biologic effects of ionizing radiation. This program drew on the talents of many university scientists and scientists in the government, notably from the National Cancer Institute and the National Bureau of Standards. The syndrome of whole-body radiation injury was clearly defined before it was observed in Japan in 1945, and experimental studies were initiated in mice on genetic effects of radiation, effects of radiation on life span, and carcinogenic action of internally deposited radioactive materials. The actual scope of health service activities by spring of 1944 was summarized as follows:

1. Surveys of skin for contamination with radioactive materials.
2. Surveys of laboratories for various types of radioactive contaminants.
3. Metering of personnel with various types of pocket ionization chambers and film meters to determine individual exposures.
4. Surveys of atmosphere for radioactivity.
5. Surveys of effluent water from the Clinton pile area to determine contamination. Methods developed here expected to be useful at Hanford.
6. Examinations of body secretions and excretions for radioactive materials.
7. Clinical laboratory examinations for various types of damages to personnel exposed to either tolerance or larger doses or radiation.

This statement still applies as a guide to those responsible for the health of workers and the public in an industrial plant handling radioactive materials.

In June 1956 the National Academy of Sciences and the British Medical Research Council published reports on the biologic effects of radiation. These reports were stimulated by concern over possible harmful effects of radiation from fallout from testing of atomic weapons. Both reports concluded that any radiation exposure might exact a biologic cost at least from the genetic standpoint. The reports further suggested that, except for exposure from natural radioactivity, medical x-rays were the largest single factor in exposure to the population as a whole. This has led to active efforts to reduce body and gonadal exposures from diagnostic and therapeutic x-rays. Each industrial medicine program in a plant which uses radiation sources of any type, even if it includes only the diagnostic x-ray machine in the plant medical office, must be cognizant of radiation as an industrial health problem. It behooves each industrial physician to become conversant with radiation medicine, treatment of radiation accidents, and methods of controlling radiation exposures generally, as well as to gain a more detailed knowledge concerning the particular radiation sources being used in the plant or plants for which he has medical responsibility.

There are too many variations in the amount and kinds of radioactive material handled for any set rules to be established. Each plant will have its own special problems. In many instances, the major share of the responsibility for radiation health protection is placed on the man most competent to bear it, whether a physician, a radiological or health physicist, or an industrial hygiene engineer. The important thing is that the responsibility is clearly assigned to someone who understands radiation protection problems. The medical director must keep close contact with the program, even if he does not administer it. He must have full understanding of the types of accidents which could arise and be prepared to handle radiation injuries quickly and competently.

Education of personnel is a further responsibility which the physician or medical director must undertake. There is so much talk of hazards of radiation that lay persons frequently become unnecessarily apprehensive about them. Considerable numbers of persons are refusing to submit to important diagnostic x-ray procedures because of something they have read or heard on the radio or television. The worker first turns for guidance to the industrial physician and the family physician who must be prepared to discuss the problem with him in simple understandable terms. The American College of Radiology has developed a useful pamphlet which should be read by every industrial physician. It can do much to place the hazards inherent in diagnostic x-ray exposure in proper perspective.

For a number of years the Industrial Medical Association and the American Industrial Hygiene Association have devoted whole sessions at annual meetings to the health problems of the atomic age. Industrial physicians should take advantage of every opportunity to learn about radiation hazards, methods for their control, and therapy of injuries incurred in accidents involving radiation and radioactive materials. (Dunham, C.M., Radiation as an Industrial Medical Problem: J. Occup. M., 1: 199-202, April 1959)

* * * * * *

Etiology of Aplastic Anemia

Aplastic anemia is not commonly associated with exposure to industrial chemicals, particularly under conditions prevalent in modern chemical plants. Early in the century, aplastic anemia was frequently noted following over-exposure to benzene, particularly in Germany, England, and Italy. The first cases of chronic benzene poisoning were recorded in 1897. Since that time, two other compounds—dinitrophenol and trinitrotoluene—have been implicated, and more recently, a mixture of DDT (dichlordiphenyltrichloroethane), chlordane (octachloro—4, 7= methanohydroindane), and lindane (benzene hexachloride) is reported to have caused aplastic anemia in a 16-year old boy. A single report of aplastic anemia due to carbon tetrachloride has been criticised for lack of proof of coincident exposure to other solvents such as benzene.

Wintrobe lists 25 drugs associated with the occurrence of aplastic anemia, and Osgood lists 25 agents known to produce hypoplastic syndromes of drug idiosyncrasy type. Of these agents, only nitrophenols are of industrial significance. Osgood prefers the term hypoplasia rather than aplasia because complete disappearance of cells from blood-forming organs practically never occurs because erythrocytic, granulocytic, and thrombocytic hypoplasia may occur separately or together. He points out that before attributing aplasia or aplastic anemia to drugs or chemicals it is necessary to keep in mind other causes of hypoplasia, such as bacterial, viral, or

parasitic infections, nutritional and endocrine deficiencies, endogenous toxins, congestive splenomegalies, thymomas, and other more rare and obscure causes of hypoplasia.

A comparison of deaths and illness from trinitrotoluene during World War I and World War II indicates the effectiveness of control measures introduced during the second World War. McConnell and Flinn summarized the findings in 22 fatalities occurring in the United States during World War II between June 1941 and September 1945—sharp contrast to the 475 deaths during the first 7-1/2 months of World War I.

In the chemical industry every effort is being made to eliminate or reduce exposure to toxic chemicals to a safe level. The possibility of exposure to TNT is much less in a manufacturing plant than in a shell-loading plant because in the latter TNT must be melted and there is more chance of inhaling fumes and dust or absorbing the compound through the skin. The The DuPont Company operated four TNT-manufacturing plants employing some 4000 persons during World War II, producing about 1-1/4 billion pounds of this explosive. By maintaining rigid standards with respect to permissible levels of TNT in the air, enforced showers after work, and the daily use of freshly laundered clothing, gloves, and caps, exposure was reduced so that no cases of toxic hepatitis or anemia developed in the 4-year period these plants were in operation.

There may be several reasons why therapeutic chemicals are more often associated etiologically with aplastic anemia than industrial chemicals. A drug is given in an effective dose which is some optimal level between the smallest amount having a therapeutic effect and the largest amount that can be tolerated without toxic symptoms. In the chemical industry, to avoid having any person subjected to even a minimal dose (a dose or exposure which produces any measurable effect) the concentration of gas, vapor, or dust in the atmosphere is kept well below permissible limits and protection against skin contact is provided. In this way, even the most toxic compounds can be manufactured and handled safely.

During the past two decades manufacturing chemists have made a concerted effort to determine in advance the possible hazards of new chemicals or products with respect to their effect on the skin, or following absorption into the body by any route, so that safety standards can be established.

Many chemical industries have a full-time in-plant medical service. Through preplacement examinations the state of the employee's health is known and must meet certain standards before he is permitted to enter an operation involving chemicals that may be toxic. The employee is examined periodically to be sure abnormal signs or symptoms are not present. The frequency of examination depends on the job and the possible hazards involved. Thus, a correlation between medical observations of the worker and measurements of the environment in which he works is possible. Individual variations are assessed and compared with variations in the group. Often, factors

outside the industrial plant are found to be responsible for individual variation. One of these factors is the large number of chemicals used therapeutically, and the number of these substances is expanding rapidly.

In 1957 seventeen million pounds of aspirin were manufactured, enough to make 23 billion 5-grain tablets. Vitamins came second on the list, to the extent of some 7 million pounds. Little or no medical guidance prevails in the use of these drugs. Instead, the public is deluged with information concerning wonder cures for a variety of symptoms.

Perhaps the introduction to so many new synthetic drugs represents progress, but at times it is disconcerting to those who are responsible for preventing injury from chemicals used in industry. Medical textbooks rightly suggest that exposure to industrial chemicals should be considered in etiology of diseases like aplastic anemia, but the odds are about 12 to 1 in favor of therapeutic agents being responsible.

Time limitations make it difficult in industry to obtain a detailed or reliable history of past exposure to drugs or chemicals at the time of a preplacement examination. Usually it is possible to obtain a history of impressive reactions, particularly skin reactions, to chemicals or drugs. The prospective employee may recall these unless he assumes it may interfere with his chance of employment. It is feasible, however, to establish that workers assigned in a specific area are of normal health or at least measure up to certain standards before being employed in a chemical operation. A normal blood picture would be one of these standards. Osgood, in discussing drug-induced hypoplastic anemias and related syndromes, points out the usefulness of the reticulocyte count to determine early unfavorable reactions to drugs, since a reduction in reticulocytes, neutrophils, or thrombocytes in the blood will long precede the development of anemia because of the long life span (120 days) of mature erythrocytes. He suggests that, owing to the difficulty in doing reliable thrombocyte counts, a clot-retraction test be performed. This procedure would be feasible in some selected industrial operations as a measure of normal thrombocytic activity. Such tests as bone marrow aspirations are not within the scope of industrial medicine. Any diagnostic test used in industry must not be too time consuming, painful, or obnoxious to the employee, and it must measure changes or trends in physiology rather than pathology if it is to serve any useful purpose in the prevention of poisoning or undue reactions from chemicals. In a periodic examination of the blood for controlling exposure to a chemical, the most likely indications of adverse effect of a chemical on the blood would be a reduction in reticulocytes, a reduction of the absolute number of lymphocytes, or a reduction in thrombocytes as measured by delayed or incomplete clot retraction. Although the reason might not be apparent, an employee exhibiting these changes may be removed at least temporarily from exposure until the reason for deviation from normal is established.

The probability of developing hypoplastic anemia from occupational exposure to chemicals is much less than from exposure to chemicals used therapeutically. The chief reason for this is inherent in the relative risk. In industry, the level of chemical exposure is normally kept below a level that would produce any effect in any worker. On the other hand, the level of chemical exposure during therapy is deliberately high enough to produce a desired response even though risk of undesirable side effects is appreciable. (Fleming, A.J., The Etiology of Aplastic Anemia - Industrial Chemicals Versus Therapeutic Chemicals: J. Occup. M., 1: 97-99, February 1959)

* * * * * *

Medical Considerations of Exposure to Microwaves (Radar)

Considerable interest in the biologic aspects of exposure to radar beams has been generated during the past year by widespread publicity of an alleged case of human death occurring after brief exposure to an unknown quantum of microwaves. The incident served to direct attention to this relatively new agent, and questions naturally arose concerning the extent of the hazard, if any, to persons working with radar transmitters and to those who might be exposed in some manner to the energized beam.

It is not generally known that apprehension over the biologic potentials of microwaves dates back to the early days of World War II, when Daily performed his original studies on U.S. Navy personnel engaged in the operation and testing of relatively low-powered radars. Although this study revealed no evidence of radar-induced pathology in human beings, numerous reports have since appeared indicating that tissue injury and animal death can occur under certain experimental conditions. These studies indicate that cataracts, corneal opacities, testicular degeneration, and hemorrhagic phenomena have been induced in anesthetized, small, furry, test animals by exposure to microwaves in the frequency range of 2800 to 9000 megacycles for various time exposures. Boysen, using a transmitter with a frequency of 300 megacylces, exposed rabbits in a wave guide and produced damage to the central nervous system, degenerative changes in the kidneys, heart, liver, and gastrointestinal tract, and hemorrhagic changes in the respiratory tree. The power density measured in the wave guide was in excess of 0.1 watts per square centimeter. The animals were exposed for periods of 7 to 10 minutes, and all whose rectal temperatures exceeded 44.5°C. (112.1° F.) died. Boysen was of the opinion that pathology and death were causally related to the hyperthermia.

Because of these findings and the apprehension engendered by their publication in scientific journals, the medical department of an airframe

manufacturer coincidentally installing, testing, and servicing the most powerful airborne transmitters, early in 1954, instituted a comprehensive medical surveillance program for its several hundred employees working with radar or those who might be exposed to the energized beam. This program constitutes one of the longest continuous medical surveys of radar-exposed personnel in the United States.

The objectives of the program were threefold: (1) to detect any cumulative biologic effects of long-time exposure to microwaves of varying frequency and power output in persons who had taken minimal precautions; (2) to observe possible effects on persons working for short periods with or near extremely highpowered airborne radar with pulsed wave emissions; and (3) to establish correlation between objective findings and units of exposure expressed in time-powered density factors with the highly idealized objective of establishing safe maximum exposure standards.

Effects of Long Periods of Exposure

The initial study included 226 radar-exposed employees and 88 non-exposed control subjects. Examination in every case included an extensive system and organ inventory with emphasis on the ocular structures, central nervous system, gastrointestinal and urinary tracts, hematopoietic system, and skin. Imbedded metallic foreign bodies were identified; a careful marital and fertility history was elicited; and duration and manner of exposure to radar was identified.

In addition, each subject was inspected for manifest hemorrhagic phenomena. A modified test for Rumpel-Leede phenomenon was then performed by means of placing the blood pressure cuff on the arm and maintaining pressure midway between the systolic and diastolic pressure for three minutes. The appearance of more than 10 fresh petechiae in a circle 4 cm. in diameter below the cuff was considered a positive result.

The second phase consisted of an ocular examination, including a slit lamp study performed with the patient subjected to cycloplegia by a competent ophthalmologist, complete blood cell and platelet counts, chest x-rays, and urinalyses.

No pathology or adverse physiologic effects unequivocally attributable to microwave exposure could be demonstrated, and no person sustained any acute or chronic injury secondary to radar exposure.

Effects of Short Periods of Exposure

Having established baseline or reference criteria, personnel were reexamined, at 6-month, then 12-month, and 24-month intervals approximately 4 years after the original study. The procedures were modified to eliminate several more costly, time-consuming, and noncontributory tests. An extensive medical questionnaire was prepared, and each subject was interviewed by a physician. Physical examinations were performed only when

indicated on the basis of the medical history or laboratory studies. Ocular and slit lamp studies were repeated, and complete blood cell counts and urinalyses were performed. Blood platelet studies were repeated on alternate years. A limited number of electrophoretic serum protein patterns were made.

The number of days of sick leave and leaves of absence and other health statistics were obtained. Also, a large number of tests for Rumpel-Leede phenomenon were performed on applicants for employment and employees seeking treatment for routine ailments. None of these subjects had had any known exposure to radar emanations.

The total exposure group increased to 335 by the addition of newly hired or reclassified employees. Persons in the one-year study generally had two examinations, in the 2-year study two or three examinations, and in the 4-year study three or four examinations.

Among the radar-exposed group, sinus, gastrointestinal, genitourinary, and dermatological complaints were most prevalent. Headaches and nervousness were the most common subjective complaints. The control group exhibited sinus, allergic, gastrointestinal, joint, and genitourinary disease prevalence, with fewer headaches and skin and respiratory complaints. There were no marked deviations or trends from the common disorders and no unusual or unexplained hemorrhagic phenomena.

No ocular finding was attributable to radar exposure. There were no cataracts characteristic of those experimentally induced in animals by hyperthermia, and the corneal scars were mainly associated with the other known causative agents. There were no tendencies toward progressive ocular diseases, and the 4-year group revealed no pathology significantly different from that of the other groups.

Sick leave for the 49 subjects who were in the 4-year group averaged 3.0 days for the year 1957 compared to 3.1 days for all factory personnel.

The blood picture of the radar-exposed and control groups was comparable in most respects. An unusually high incidence of increased monocytes and eosinophils was noted. Of the 49 subjects studied over 4 years, only one had a reduced blood platelet count. Of the 88 subjects used in the original control group, positive results were noted in 8%.

In 26 cases selected at random, electrophoresis of serum proteins was performed at a hospital laboratory. Many of these specimens were from subjects in the 2-year and 4-year groups. In only one subject was the deviation more than slight or considered significant, and this was partially reversed within 2 months after elimination of an active known infection.

Maximum Exposure Standards

The delineation of safe maximum exposure standards was contingent upon detection of pathologic changes in the subjects and determination of the exposure parameters with respect to frequency or wave length, field power

density, exposure time, and total test environment. It soon became apparent that this objective could not be achieved in the study because no pathology caused by either single or repeated exposure was uncovered. The majority of personnel had been exposed to radars from transmitters operating in a frequency range of 400 to 9000 megacylces including powerful "S" band components. It was impossible to obtain precise data covering exposure time and average field power density because often these were unknown. Exposure varied from an occasional incidental contact with the beam to as much as 4 hours daily close exposure periods up to 4 years. Exposures of several minutes a day at distances of less than 10 feet from the radars were not uncommon.

Protective clothing was not worn by any of the subjects while in the radar beam. Personnel were advised to avoid exposure to any firing beam when in a zone defined by a minimum power density of 0.0131 watts per square centimeter. A second zone, extending from the area previously defined to that with a minimum power density of 0.0039 watts per square centimeter, was deemed acceptable for occasional pass-through but no constant exposure. The third was a limitless zone in which exposure was not deemed biologically significant.

Unfortunately, because most persons are exposed to radar emanations while on the ground and frequently within the so-called near radar field, it is extremely difficult to evaluate biologic effects and hazards in relation to absolute power levels without accurate measurements. The need for such accuracy in quantitative determinations of exposure is obvious and can be achieved by the development of exposure meters reflecting absorption in quantum units of radar energy.

It has been suggested that the sensation of heat is almost universal on exposure to radar and that this in itself is indicative of an overexposure. In this study, only 17% of the 335 subjects experienced heat sensation and frequently only when in close proximity to "X" band radars. Almost 6% were aware of a buzzing or pulsating sensation when in an "S" band field. Less than 1% experienced other sensations or warning phenomena, such as sparking between dental fillings or a peculiar metallic taste. Eight subjects gave a history of metallic implants, such as bullets, buckshot, steel pins, and plates. None experienced any unusual reaction attributable to the metal. There were no complaints of heat directed to rings, wrist watches, or bracelets.

Comment

During the past 18 years, thousands of persons in the course of their employment or while in military service have been exposed to microwaves, many without protection. Concern over the effects of such exposure is natural and to be expected. The majority of radars in common use today are relatively low powered with the exception of some military transmitters which

exceed one megawatt in peak power output. Radars with many times this power will be operational in due course and may radically change the entire concept of the biologic potentials of this form of energy.

Experiments have been conducted primarily on small fur-bearing animals and under unusual test conditions. It is generally accepted that the modus of injury by microwaves is a hyperthermia produced by absorption of this form of energy by the body. Extreme caution must be exercised in attempting to extrapolate the results of small animal responses to heat to those of the human body. Small fur-bearing animals have a high coefficient of heat absorption, a small body surface, and a relatively poor heat regulating system. The human body, by comparison, has an excellent heat regulating system and can readily adjust and maintain thermal homeostasis under severe stress conditions. Adequate physiologic function can be maintained in environments of 240° F. for 23 minutes if the humidity is low; at least one subject has been exposed to a temperature of 400° F. for approximately one minute without tissue injury.

Conditions of radar operation and testing vary from experimental conditions. Human beings are generally exposed while in free air and rarely to a stationary energized beam. Some radar beams are extremely narrow, and only a small portion of the human body is instantaneously exposed. The body can dissipate heat readily to the environment between such exposures. One is reminded of a similar problem associated with exposure of personnel to the thermal effects of ultrasonic energy. In an analogous situation, small fur-bearing animals were destroyed by hyperthermia when placed in a jet engine noise field, yet there is no evidence of any adverse heating effects on man when exposed to the same environment. It has been estimated that it would require many million times the ultrasonic energy of that generated by any current jet engine to produce these effects in human beings.

A case is recorded of accidental 15-second exposure at a 6 to 10-inch distance to an "X" band radar of over 100,000 watts in peak power output, with resultant erythema and a sensation of warmth for an hour, but with full and uneventful recovery. Unless carefully controlled and operated, microwave diathermy with use of "S" band frequencies can cause local tissue damage.

The study revealed no acute, transient, or cumulative physiologic or pathologic changes in subjects working with, and frequently exposed to, high-power radar transmitters. Therefore, it would appear extremely unlikely that there exists a biologic hazard to the radar technician observing reasonable precautions or that the general public, exposed to greatly attenuated and intermittent doses of microwaves in the environment, is in any danger of body injury.

There is need for additional research to explore the effects on living tissue of extended wave lengths and frequencies of microwaves and transmitters of higher energy.

With the increasing exposure to microwaves in and around the home as well as in industry, careless and scientifically uncorroborated report of human injury and death cannot avoid receiving dramatic and widespread dissemination. If radar is incriminated, the report must contain a definite history of exposure, including proper identification of the transmitter, wave length, power density, exposure time, symptomatology, laboratory data, pathologic findings, and other factors. (Barron, C.I., Baraff, A.A., Medical Considerations of Exposure to Microwaves (Radar): J.A.M.A., 168: 1194-1199, November 1, 1958)

* * * * * *